

What is claimed is:

1. A system for providing page messages to radio paging units over a wide area through a plurality of transmission systems in which each of said transmission systems are associated with a predefined coverage area in said wide area, said system comprising:

a controller having memory storing a routing database registering each of said paging units with one of said transmission systems, in which said controller routes page messages received by said system to each of said paging units through one of said transmission systems to which the paging unit is registered in accordance with said routing database, wherein the transmission system to which each of the paging units is registered represents the transmission system registered to the paging unit;

a plurality of transmission systems, each of said transmission systems having means for sending page messages received from the controller to paging units, and means for sending periodically a system message having at least information which uniquely identifies the transmission system;

a plurality of paging units for receiving the system messages of at least one of the transmission systems when located in the associated coverage area of said one transmission system and receiving the page messages from the transmission system registered to the paging unit when the paging unit is located in the coverage area of the transmission system registered to the paging unit;

each of said paging units having means for determining when the paging unit receives at least one of the system messages sent by one of said transmission systems different from the transmission system registered to the paging unit, and means, responsive to said determining means, for sending to the controller at least the information uniquely identifying the transmission system from said received system message sent by one of said transmission systems different from the transmission system registered to the paging unit; and

said controller having means, responsive to said sending means of each of said paging units, for updating the registration of the paging unit in the routing database to one of the transmission systems in accordance with the information received from the sending means of

the paging unit, and sending to the paging unit at least information representing the updated transmission system registered to the paging unit, in which the paging unit receives, and operates the determining means of the paging means responsive to, the information representing the updated transmission system.

2. The system according to Claim 1 wherein each of said paging units has memory storing the information representing the registered transmission system of the paging unit, and updates said memory of the paging unit in accordance with the information representing the updated transmission system received from the controller.

3. The system according to Claim 1 wherein said updating and sending means of the controller updates the registration, responsive to the sending means of each of the paging units, to one of the transmission systems provided in the information from said sending means of the paging unit and another of the transmission systems having approximately the same coverage area as the transmission system identified by the information from said sending means of the paging unit.

4. The system according to Claim 1 wherein each of said transmission systems has a unique identifier and the system message sending means of each of the transmission systems sends the system message having at least the unique identifier for the transmissions system, wherein said unique identifier represents the information uniquely identifying the transmission system.

5. The system according to Claim 4 wherein said unique identifier of each of said transmission systems represents a unique first identifier comprising at least a second identifier representing the coverage area associated with the identifier in said wide area and a third identifier representing the frequency of transmission of the transmission system.

6. The system according to Claim 5 wherein each of the paging units has a receiver which, responsive to receiving the first identifier of the updated transmission system registered to the paging unit from the controller, is set to receive paging messages and system messages for the frequency of transmission in accordance with the third identifier of the first identifier of the updated transmission system.

7. The system according to Claim 4 wherein the sending means of each of the paging unit sends at least information including said first identifier of the transmission system of the received system message, and the updating and sending means of the controller, responsive to the sending means of each of the paging units, updates the registration of the paging unit to the first identifier of the transmission system having at least the second identifier which is the same as the second identifier of the first identifier received from the sending means of the paging unit.

8. The system according to Claim 5 wherein the sending means of each of the paging unit sends at least said information including said first identifier of the received system message, and the updating and sending means of the controller, responsive to the sending means of each of the paging units, updates the registration of the paging unit to the first identifier of the transmission system having the second identifier which is the same as the second identifier of the first identifier received from the sending means of the paging unit and the third identifier representing the frequency of the transmission system having available page messaging capacity in the coverage area associated with the second identifier of the first identifier received from the sending means of the paging unit.

9. The system according to Claim 1 wherein one or more of the transmission systems have approximately the same coverage area, and said transmission systems having approximately the same coverage area operate on different transmission frequencies in which at least one transmission system in each of the coverage areas in said wide area operates on a common frequency, and each of said paging units are capable of receiving the system

messages and the page messages on the transmission frequency of the registered transmission system of the paging unit.

10. The system according to Claim 9 wherein each of said paging units, responsive to receiving an updated registered transmission system, receives the system messages and the page messages on the transmission frequency of the updated transmission system.

11. The system according to Claim 1 wherein said updating and sending means of the controller sends the information representing the updated transmission system to the paging unit in a confirmation message.

12. The system according to Claim 11 wherein said updating and sending means of the controller sends the confirmation message by routing the confirmation message through the transmission system ^{identified} ~~provided by~~ the sending means of the paging unit.

13. The system according to Claim 1 wherein each of said paging units further comprises memory and means for recording one or more time periods in said memory of the paging unit when the reception of page messages is unlikely in accordance with the paging unit not receiving the system message of the transmission system to which the paging unit is registered within a predefined interval.

14. The system according to Claim 13 wherein said sending means of each of said paging units further comprises means for sending to the controller data representing said time periods in said memory of the paging unit.

15. The system according to Claim 13 wherein each of said paging units further comprise means for sending to the controller data representing said time periods in said memory of the paging unit when one of a certain input from the user of the paging unit is

received by the paging unit, and one or more of said time periods exceed a predefined interval.

16. The system according to Claim 13 wherein said recording means of each of said paging units further records one or more time periods when the paging unit is logically off.

17. The system according to Claim 14 wherein said controller further comprises:
a time source for providing time information;

a message database stored in said memory of the controller having copies of each of the page messages routed to each of the paging units with at least the time information from said time source when the page message was routed; and

means for receiving the data representing said time periods and resending any page messages sent during said time periods to the paging unit which sent the data in accordance with said message database.

18. The system according to Claim 4 wherein said unique identifier of each of said transmission systems represents a unique first identifier, each of said paging units has a unique unit identifier, and said sending means in each of said paging units comprises:

means for sending to the controller at least the unit identifier of the paging unit and the first identifier of the transmission system from the received system message sent from one of the transmission systems different than the transmission system to which the paging unit is registered.

19. The system according to Claim 18 wherein said routing database associates the unit identifier of each of said paging units to the first identifier of the transmission systems to which the paging unit is registered.

20. The system according to Claim 19 wherein said updating and sending means of the controller revises the routing database to register the paging unit of the received unit identifier to one of the first identifier of the transmission system in the information received

from the sending means of the paging unit, and the first identifier of the transmission system having approximately the same coverage area as that associated with the first identifier of the transmission system in the information received from the sending means of the paging unit.

21. The system according to Claim 1 wherein said sending means of each of the paging units comprises means for notifying the user of the paging unit of the need to update the registration of the paging unit.

22. The system according to Claim 1 wherein:
one or more of said paging units represent two-way paging units;
one or more of said transmission systems have a two-way paging receiver network capable of communication with ^{the} ~~then~~ two-way paging unit when located in their coverage areas; and

said sending means of each of the paging units comprises means for sending, via the two-way paging receiver network of one of the transmission system, to the controller at least the information identifying the transmission system from the system message received from one of the transmission systems different from the registered transmission system of the paging unit.

23. The system according to Claim 22 wherein:
each of said transmission systems further sends information in said system message indicating whether the transmission system has a two-way paging receiver network; and
said sending means of the paging units representing two-way paging units communicate to the controller via one of the two-way receiving network, when the received system message sent from one of the transmission systems other than the transmission system to which the paging unit is registered has the information indicating a two-way paging receiver network is available, ^{and} ~~of~~ a telephonic-based connection to the controller.

24. The system according to Claim 1 wherein:

each of said transmission systems further comprises a time source for provide time information, and sends in said system message the time of transmission of the system message in accordance with said time information; and

said paging units each have a clock which is maintained in correspondence with the time of transmission of one or more of the system messages received by the paging unit.

25. The system according to Claim 1 wherein each of said transmission systems further sends in said system message at least one access number associated with the controller.

26. The system according to Claim 25 wherein said sending means of each of said paging units connects to the controller in accordance with the access number of the received system message to send data representing at least the information from the received system message identifying the transmission system which sent the received system message.

27. The system according to Claim 25 wherein said access number represents a telephone number associated with the controller.

28. The system according to Claim 1 wherein said sending mean of each of said paging units comprises an audio interface integrated on the paging unit capable of transmitting audio signals for establishing a telephonic connection to the controller and transmitting data to the controller.

29. The system according to Claim 1 wherein said sending means of each of said paging units further comprises:

an external interface for sending signals; and

a device for receiving said signals and establishing a connection with the controller for transmitting data.

30. The system according to Claim 29 wherein said device represents one of a cell and land telephone capable of receiving said signals from said external interface.

31. The system according to Claim 1 wherein said sending means of each of said paging units further comprises means for transmitting data to the controller via a telephonic connection enabled by the user of the paging unit.

32. The system according to Claim 31 wherein said transmission means of one or more of said paging units further comprises one or more push buttons on the paging unit to establish said telephonic connection and send data to the controller.

33. The system according to Claim 1 wherein said sending means of each of said paging units further comprises means for automatically establishing telephonic connection to the controller for transmitting data.

34. The system according to Claim 1 further comprises one or more control input units which receives data from the sending means of each of the paging units and transmits said received data to said controller representing at least information which uniquely identifies the transmission system having sent the last system message received by the paging unit and uniquely identifies the paging unit.

35. The system according to Claim 1 wherein said sending means of each of said ^{sends} paging units ^{utilizes} ~~utilizes to send~~ data to said controller ^{by} ~~one of~~ a telephonic-based connection and two-way paging network.

36. The system according to Claim 1 further comprising at least one message input unit for receiving page messages for the controller having information designated to one or more of said paging units for routing to the transmission systems to which the paging units are registered.

37. The system according to Claim 1 wherein said memory of the controller stores a group database identifying groups of one or more of said paging units under unique group identifiers, and said controller further comprises means for receiving a page message referencing one of the group identifiers and routing said page message to each of the paging units of group in accordance with said group database through the registered transmission system of the paging unit in accordance with the routing database.

38. The system according to Claim 37 wherein each of said paging units has a unique unit identifier and further comprises means for receiving paging message addressed to one of the unit identifier for the paging unit and one of the group identifiers to which the paging unit is associated.

39. The system according to Claim 1 wherein the information in each of the system messages which uniquely identifies the transmission system sending the system message comprises a regional identifier representing the coverage area of the transmission system, a frequency identifier representing the frequency at which the transmission system operates for transmitting page messages, and a system identifier distinguishing said system from any other systems for providing page message to paging units.

40. The system according to Claim 1 wherein each of said paging units further comprise:

a paging receiver for receiving paging messages and system messages when located in the coverage area of at least one of the transmission systems;

at least one first decoder for decoding received system messages;

at least one second decoder for decoding received paging message when addressed to the paging unit;

at least one third decoder for decoding received page messages when said paging messages are designated to one or more groups the paging units is a part of; and

a paging unit controller for enabling said determining mean and sending means.

41. The system according to Claim 1 wherein said means for sending periodic system messages for each of said transmission systems comprises:

- a time source for providing date and time;
- a system message generator for generating periodically the system messages having said information uniquely identifying said transmission system and said date and time from said time source;
- a paging encoder for encoding generated system messages in accordance with a paging protocol;
- a regional controller for formatting the encoded system messages; and
- one or more transmitter sites having antennas which broadcast said formatted encoded system messages in the coverage area of the transmission system.

42. The system according to Claim 41 wherein said means for sending page messages for each of said transmission systems includes said paging encoder for encoding page messages received from the controller, said regional controller for formatting the encoded page messages, and said one or more transmitter sites for broadcasting said formatted encoded page messages.

43. The system according to Claim 1 wherein each of said paging units when not receiving said system message from the transmission system to which said paging unit is registered within a predefined interval enters a no service state until one of the system messages from the transmission system to which said paging unit is registered is again received, and said paging unit receives from said controller information identifying the updated transmission system registered to the paging unit.

44. The system according to Claim 43 wherein said paging units each further comprises:

- a time source for providing time information;
- memory; and

means for recording one or more time periods in an array in said memory in accordance with said time source when the paging unit is in the no service state.

45. The system according to Claim 43 wherein:

one or more of the transmission systems have approximately the same coverage areas and said transmission systems having approximately the same coverage areas operate on different frequencies to send paging messages and system messages;

at least one of said transmission systems in each different coverage area operates on a common frequency;

each of the paging units are capable of receiving page messages and system messages on the different frequencies; and

each of the paging units after entering the no service state reset the frequency of reception to the common frequency.

46. The system according to Claim 1 wherein said controller further comprises:

a time source for providing date and time;

a message database stored in said memory of the controller having copies of each page message routed to each of the paging units with the time from said time source that the page message was routed.

47. The system according to Claim 1 wherein each of said paging units represent one of one-way or two-way paging units.

48. The system according to Claim 1 wherein the information sent in the system message from each of the transmission systems uniquely identifying the transmission system represents a unique identifier for the transmission system, and each of said paging units further comprises:

memory storing at least the identifier of transmission system to which the paging unit is registered; and

said determining means has means for comparing the identifier stored in said memory with the identifier of each received system message to determine when the paging unit receives one of the system messages sent from one of said transmission systems different from the transmission system to which the paging unit is registered.

49. The system according to Claim 1 wherein each of said transmission systems comprises one or more transmission sites in the coverage area associated with the transmission system for enabling page messages to reach the paging units in the coverage area associated with the transmission system.

50. A system for providing page messages to radio paging units over a wide area through a plurality of regional transmission systems, said system comprising:

means for routing page messages to each of said paging units through one of said transmission systems to which the paging unit is registered, each of said paging units being registered to one of said transmission systems;

a plurality of transmission systems having coverage areas in said wide area in which each of said transmission systems sends page messages received from the controller to paging units located in their associated coverage area and sends a periodic system message having information which uniquely identifies the transmission system to paging units located in their associated coverage area;

a plurality of paging units capable of receiving page messages and system messages when located in the coverage area of at least one of the transmission systems in which each of said paging units, when receiving at one of the system messages sent from one of said transmission systems different from the transmission system to which said paging unit is registered, transmits to the controller at least the information from the received system message identifying the transmission system; and

said routing means in response to each of said paging units comprises means for re-registering the paging unit to one of the transmission systems whose coverage area the paging unit has entered in accordance with the information received from the paging unit.

51. The system according to Claim 50 wherein said re-registration means further comprises means for sending to the paging unit information having at least the transmission system to which the paging unit is re-registered.

52. The system according to Claim 50 further comprising:
means for maintaining in a database copies of each of the page message routed to one or more of said paging units with the time routed;
means in at least one of the paging units for determining any time periods in which system messages were not received after a predefined interval from the transmission system to which the paging unit is registered; and
means for sending from the database copies of any page messages sent to a paging unit which were routed during any of said time periods.

53. A method for providing page messages to radio paging units over a wide area through a plurality of regional transmission systems comprising the steps of:
registering each of said paging units to one of said transmission systems;
routing page messages to each of said paging units through one of said transmission systems to which the paging unit is registered;
sending routed page messages by each of the transmission systems to the paging units located in their associated coverage areas;
sending a periodic system message from each of said transmission systems having information which uniquely identifies the transmission system to any of said paging units located in their associated coverage area;
receiving the page messages sent to each paging unit from the transmission system registered to the paging unit;
receiving at least one system messages at each of the paging units when the paging unit is located in the coverage area of at least one of the transmission systems;
re-registering each of the paging units to a different one of said transmission systems from the transmission system the paging units is registered when the paging unit receive at

least one of the system messages sent from one of said transmission systems different from the transmission system to which said paging unit is registered; and
sending to each of said paging units the transmission system to which the paging unit is re-registered.

54. The method according to Claim 53 further comprising:
recording one or more time periods in which the paging unit does not receive within a predefined interval the system message of the transmission system to which the paging unit is registered;
storing in a message database copies of each page message routed to each of the paging units with the time information that the page message was routed; and
resending any page messages routed to the paging unit during said time periods in accordance with said message database.

55. A method for routing page messages to paging units through one or more transmission systems comprising the steps of:
receiving page messages, each of said page message having message data and identifying information of the paging units to receive the page message;
storing in at least one first database associating each paging unit to one of the transmission systems;
routing each page message received to one of the transmission systems in accordance with said identifying information of the page message and said first database;
storing in at least one second database information about each page message routed representing at least the paging unit associated with the page message in accordance with the identifying information of the page message, the message data of the page message, and the time the page message was routed;
maintaining in at least one of the paging units one or more records of certain time periods; and

resending page messages to at least one of the paging units from said second database any message sent to the paging unit which having a time routed during said certain time periods.

Sub 56. The method according to Claim 55 further comprising the step of updating said first database to associate one of the paging units with another of the transmission systems after the one paging unit moves into the coverage area of one of the transmission systems different from the transmission system to which the paging unit is registered.

Sub 57. A controller for routing messages to radio paging units in a wide area paging system having one or more transmission systems with coverage areas in the wide area, in which the radio paging units can detect when they have moved into a new coverage area of one of the transmission systems and communicate to the controller information related to the transmission system of the new coverage area, said controller comprising:

memory storing a routing database registering each of said paging units with one of said transmission systems;

means for routing page messages to each of said paging units through one of said transmission systems to which the paging unit is registered in accordance with said routing database; and

means, responsive to the receiving a communication from the paging unit with information related a coverage area, for updating the registration of the paging unit in the routing database to one of the transmission systems in accordance with the information received from the sending means of the paging unit, and sending to the paging unit at least information representing the updated transmission system registered to the paging unit.

58. A radio paging unit for receiving messages from one or more regional transmission systems in a wide area in which each radio paging unit is registered to one of the transmission systems for receiving paging message from the transmission system, and each

transmission system sends a periodic system message identifying the transmission system, said radio paging unit comprising:

means for receiving the system messages of at least one of the transmission systems when the paging unit is located in the associated coverage area of said one transmission systems, and receiving the page messages sent from the transmission system registered to the paging unit when the paging unit is located in the coverage area of the transmission system registered to the paging unit;

means for determining when the paging unit receives at least one of the system messages sent by one of said transmission systems different from the transmission system registered to the paging unit; and

means, responsive to said determining means, for sending to the controller at least the information uniquely identifying the transmission system from said received system message sent by one of said transmission systems different from the transmission system registered to the paging unit.

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